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Expanding Vocal Requesting Repertoires via Relational Responding in Adults with Severe Developmental Disabilities

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The purpose of this project was to demonstrate untrained vocal requests in three adults with severe developmental disabilities. Specifically, we evaluated whether a history of reinforced relational responding would give rise to untrained vocal requests for novel items. Participants were first taught to request preferred items using their category names. They were then taught conditional discriminations between pictures of preferred items that were categorically related. Finally, participants were tested for their abilities to request items that had not been originally presented during request training, using their category names. All participants demonstrated untrained requests, and for some participants, changes in the mand repertoire were accompanied by changes in the tact repertoire. Some participants also showed generalization of skills across settings.

Key Words: request, derived stimulus relations, relational learning, verbal behavior, mand, tact, mental retardation.

Skinner defined the mand as "a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation" (Skinner, 1957, pp. 35–36). Like the other verbal operants in Skinner's taxonomy, mands are strengthened and weakened by direct contact with reinforcement contingencies. Adults with severe developmental disabilities often lack effective mand repertoires. This may be due in part to their limited vocal abilities, as well as to a lack of formal language instruction earlier in life. In addition, some individuals may have acquired socially inappropriate means of manding for desired items. Given the focus upon community integration and inclusion of adults with severe disabilities in the rehabilitation services field today, the establishment of effective and appropriate mand repertoires for such individuals is critical.

Individuals who lack intelligible speech are often candidates for such augmentative and alternative communication systems as manual sign, which involves approximations of hand gestures used in American Sign Language, a complex visual-spatial language that is used by the deaf community in the United States and English-speaking parts of Canada (Nakamura, 1995), and the Picture Exchange Communication System (PECS) (Bondy & Frost, 1993, 1994), in which a picture of a desired item is exchanged with a caregiver for access to the item itself (see Chambers & Rehfeldt, 2003). Vocal mand training may be appropriate for individuals who possess minimal vocal repertoires with some speech that is intelligible to others. Research has supported the efficacy of discrete trial teaching methods in establishing vocal mand skills. Such procedures often entail presenting a preferred item while simultaneously asking the individual, "What do you want?" vocally prompting a correct response, reinforcing correct responses with access to the requested item, and using constant or graduated time delay procedures to fade the vocal prompt (e.g., Charlop, Schreibman, & Thibodeau, 1985; Drash, High, & Tudor, 1999; Shafer, 1994; Simic & Bucher, 1980). It is important that an economic and efficient instruc-

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tional protocol be adopted, particularly when teaching language skills to adults with severe disabilities. Agency staff seldom have time for multiple hours of one-on-one instruction. Needed are instructional approaches that will result in a number of new skills within reasonable periods of instructional time.

A possible strategy for expanding mand repertoires is inspired by Relational Frame Theory (RFT), a current behavior analytic explanation for human language and cognition (Hayes, Barnes-Holmes, & Roche, 2001). Unlike Skinner's analysis of verbal behavior, which contends that like nonverbal behavior, verbal behavior is contingency-shaped, RFT proposes that true verbal behavior is not established via direct contact with contingencies of reinforcement, but emerges via a history of reinforcement for responding in accordance with a range of contextually controlled, arbitrarily applicable relations known as relational frames (Barnes-Holmes, Barnes-Holmes & Cullinan, 2000; see also Chase & Danforth, 1991). After a history of reinforcement for responding correctly to so many exemplars, a repertoire of derived relational responding is established. Derived relational responding is thus argued to constitute true verbal behavior according to this account. Barnes-Holmes et al. (2000) recently argued for a synthesis of Skinner's analysis of verbal behavior and RFT, the concept of *derived manding* being one example of such a synthesis. As the authors describe,

> a nonverbal type involves the explicit training of a particular mand to a particular object, as when a child in a toy shop mands for a toy car because in the past manding for a car resulted in the parent actually buying the toy car and presenting it to the child. The verbal type, however, involves the manded stimulus participating in relational frames with other stimuli. In this example, the frame may contain toys in general. The child learns to say "toy" in the presence of cars, train sets, dolls, and so forth, and the child learns to mand at least one toy. Then, the child need not learn to ask for each specific toy from scratch; the child merely has to respond to the object as participating in a frame of coordination with other toys (Barnes-Holmes et al., 2000, p. 72).

To build upon this example, a toy car, for instance, may be conceptualized as discriminative for the child's requesting (a form of manding) "toy" upon encountering it in a toy store. Based upon the participation of toy car in a relational frame with a toy horse and a toy bear, the discriminative functions of requesting "toy" may transfer to the horse and the bear, such that in their presence, the child may similarly mand for a toy in the absence of direct training. In other words, the function of one stimulus in the derived relation (the car) alters the functions of the other stimuli in the relation (the horse and the bear) without additional training (Dougher & Markham, 1994; 1996; Hayes, 1991; see also Dymond & Rehfeldt, 2000). Following the authors' logic, programming for the emergence of derived mands appears to be an economical and efficient means of expanding verbal repertoires, as new skills may emerge on the basis of a history of relational responding.

A recent study by Rehfeldt and Root (in press) demonstrated the emergence of derived requests in adults with severe disabilities. Participants learned to request preferred items using PECS, in which they exchanged pictures of preferred items for access to those items. Participants then learned to conditionally relate the pictures to their corresponding dictated names, and the dictated names to their corresponding printed words. Following the emergence of derived stimulus relations between the pictures, dictated names, and printed words, participants exchanged the appropriate printed words to request access to preferred items. The purpose of the present experiment was to extend the demonstration of derived manding to vocal requesting. Participants in this study were taught to vocally request three preferred items using their category names (i.e., fruit, music, and money). They were then taught to conditionally relate those items to other novel items of the same category (for example, relating apple to banana). Finally, participants were tested for their ability to request the novel items using their correct category name. For two of the three participants, the stimulus relations had been established in their repertoires prior to training. However, the two participants had not been taught to request the preferred items using their category names. For these two participants, we questioned whether establishing preferred items as discriminative for requesting would result in the transfer of discriminative functions to the other stimuli conditionally related to those preferred items. We also evaluated whether the emergence of untrained requests would be accompanied by changes in the tact repertoire for all participants (see Sundberg, San Juan, Dawdy, & Arguelles, 1990; Drash et al., 1999; Twyman, 1996). Generalization across settings of all emergent skills was additionally examined.

METHOD

Participants

Three participants attending a community rehabilitation program in southern Illinois participated in this study. Josh was a 29-year-old male diagnosed with severe mental retardation, cerebral palsy, impulse control disorder, and intermittent explosive disorder. Josh had an IQ of 32 according to the Stanford Binet Intelligence Scale form L-M. The Social and Communicative subsection of the Inventory for Client and Agency Planning (ICAP) indicated that Josh communicated at an age equivalent of 3 years and 11 months. Josh communicated using 1- to 2-word utterances.

Ray was a 57-year-old male diagnosed with severe mental retardation and psychotic disorder NOS. An IQ score for Ray was not available. The Social and Communicative subsection of the ICAP indicated that Ray communicated at an age equivalent of 1 year and 8 months. Ray used 1 or 2 word utterances and manual sign to communicate.

Jayne was a 26-year-old female diagnosed with severe mental retardation, cerebral palsy, and epilepsy. Jayne had a reported IQ of 36. The Social and Communicative subsection of the ICAP indicated that Jayne communicated at an age equivalent of 3 years and 4 months. Jayne communicated using 1-2 word utterances.

Setting & Stimulus Materials

Sessions were held in a secluded classroom at the participants' developmental training center. The room included two long tables and several chairs. Materials included nine preferred items identified for each participant that were categorically related in three sets of three items, pictures of those same nine items, and a stimulus placement board. The placement board was 14" long and 22" wide (35.56cm x 55.88cm), and contained three 3" x 5" (7.62 cm x 12.7 cm) rectangular shapes horizontally aligned. The rectangular shapes were drawn equidistance apart. The pictures of preferred items were digitized and printed on 3" x 5" (7.62 cm x 12.7 cm) cards. A stopwatch was used to monitor reinforcer access time. Generalization probe trials were conducted in a class room also located in the participants' developmental training center, which contained two long tables, two desks, and over 20 chairs. Ten to 12 people were present in the room during generalization probes.

For ease of convenience, alphanumerical symbols were used to denote the items that were used for each participant. For Josh and Ray, the stimulus categories included: stimuli A1B1C1 (music, where A1 was a CD; B1 was a Walkman®; and C1 was a small portable radio), A2B2C2 (money; where A2 was a dollar bill; B2 was loose change; and C2 was a wallet), and stimuli A3B3C3 (fruit; where A3 was a small piece of pear; B3 was a small piece of apple; and C3 was a small piece of banana). Jayne's stimuli also included the music and fruit categories, but stimuli A3B3C3 belonged to a movie category for Jayne, where A3 was a small portable television; B3 was a videotape; and C3 was a small portable VCR.

During all experimental sessions, participants were engaged in simple interactive leisure activities with the instructor (i.e., playing checkers or cards) over the course of which the training and test probe trials were presented.

Design

A multiple probe design across participants was used. Pre-test probes of participants' abilities to vocally request and tact the nine preferred items using their category names were initially presented. Stimulus relations between the pictures of categorically related preferred items were also probed. Generalization pre-test probes for untrained requests, tacts, and stimulus relations were additionally conducted. When vocal request pre-test probes were judged to be visually stable for all participants, vocal request training was introduced for one participant. Stability in request pre-test probes was defined as a series of three data points that did not increase in level. When the first participant attained criterion performance during request training, conditional discrimination training was introduced, in which the participant was taught to conditionally relate pictures of categorically related preferred items (i.e., pictures of a CD, Walkman®, and portable radio). Post-test probes were presented following the demonstration of criterion performance during conditional discrimination training. Probes were repeated for all participants each time the first participant demonstrated criterion performance during request training and conditional discrimination training. The second participant began request training once the first participant demonstrated untrained vocal requests on post-test probe trials. The same sequence followed for the remaining participant.

Procedure

Stimulus preference assessment. Prior to training, a multiple stimulus preference assessment without replacement (DeLeon, & Iwata, 1996) was conducted with all three participants. Items were identified for inclusion in the assessment based upon interviews with staff who knew the participants well. For Josh, items included a video, a magazine, drawing materials, music, coke, money, fruit, a puzzle, and crackers. For Ray, items included a puzzle, music, candy, a video, money, fruit, crackers, and coke. For Jayne, items included a video, a puzzle, a book, drawing materials, music, fruit, candy, crackers, and pictures of horses. The assessment was conducted by presenting the items/activities in a horizontal line on the table in front of the participant. Participants were verbally prompted to choose an item, if necessary. After selecting the item, the participant was allowed 30 s to consume the item, or engage in the activity (i.e., watching the video or listening to music), after which the item was removed from the selection displayed on the table. After the item was removed, the remaining items were randomized on the table and the participant was given another verbal prompt, if needed, to choose another item. This process was repeated until all of the items on the table were chosen. This procedure continued at least five times, or until there was a clear order of preference. Josh and Ray's preferred items and activities included music, money, and the edible items, and Jayne's preferred items and activities included music, the edible items, and movies. Teaching participants to request these preferred items was deemed to be functionally relevant by staff at the rehabilitation facility. Participants had the opportunity to request money for making vending machine purchases over the course of their day at the rehabilitation facility.

Pre-Test Probes

Vocal requests, tacts, and stimulus relations were evaluated on probe trials. Participants' abilities to vocally request nine preferred items, which were categorically related in three sets of three items, were tested. Participants' abilities to request the items using their category names (i.e., "fruit") were specifically evaluated. The presentation of one item and the question "What do you want?" marked the onset of each trial. Requesting skills were tested in three 9-trial blocks with three trials presented for each item per block. Participants' abilities to vocally tact a preferred item in its presence when asked "What is this?" were tested in three nine-trial blocks, with three trials presented for each item per block. Participants were allowed 10 s to respond before an incorrect response was scored. Stimulus relations between the pictures of categorically related preferred items were tested in 36 total test trials. These included nine for the B-A relations, nine for the C-A relations, nine for the B-C relations, and nine trials for the C-B relations. All test probe trials were presented in a random order. No feedback was delivered on probe trials, nor were participants allowed access to preferred items.

Pre-Test Generalization Probes

Generalization of requests, tacts, and stimulus relations across settings was examined prior to training. The probes were identical to the pre-test probe trials.

Request Training

Participants were taught to request three of the nine preferred items, with one item being from each category. Specifically, participants were taught to request stimuli B1, B2, and B3 using their respective category name (i.e., "fruit", "music," "money," and "movie"). Discrete trial teaching procedures were used. The presentation of an item and the question "What do you want?" marked the onset of each trial. If the participant requested the item using the individual item name, the instructor asked, "What else?" During the first three-trial blocks, verbal feedback was provided for both incorrect (i.e., "No, sorry!") and correct (i.e., "Nice job!") responses. After the first three-trial blocks, a graduated time delay procedure was introduced. Initially, a vocal prompt was presented immediately following the presentation of the item and question (i.e., "Say fruit"). When a correct response was emitted, the participant was given access to the item for 30 s. The delay before the presentation of the vocal prompt was systematically increased to 4 s, until the participant independently requested all three stimuli using their category names on at least 8/9 trials for three consecutive nine-trial blocks.

Conditional Discrimination Training

Conditional discrimination training was conducted using a simultaneous match-to-sample procedure. Specifically, participants were taught to conditionally relate pictures of categorically related preferred items. The onset of each trial was marked by the instructor handing the sample stimulus to the participant, displaying three comparison stimuli upon the stimulus placement board, and instructing the participant to "Put with same." Trials were conducted in nine-trial blocks with each of the three sample stimuli A1, A2, and A3 presented three times per block. The order with which sample stimuli were presented was random. A-B relations were trained first, followed by the A-C relations. A mastery criterion of 8/9 correct for three consecutive blocks was required during A-B and A-C training. Mixed A-B and A-C relations were trained next in 18-trial blocks, with a mastery criterion of 16/18 correct responses for at least three consecutive blocks in effect.

Verbal feedback was provided for correct and incorrect matches for all participants. For Jayne, such feedback was provided only during the first three blocks of training. Following her first three trial blocks, a graduated time delay procedure was introduced. Immediately following the presentation of sample and comparison stimuli, a gestural prompt was presented. Correct matches were verbally praised. The delay before the presentation of the gestural prompt was systematically increased to 4 s, until Jayne correctly matched sample and comparison stimuli in the absence of gestural prompts on at least 8/9 trials for three consecutive nine-trial blocks. The procedure was repeated for A-C training for Jayne. The time delay procedure was not used during mixed A-B and A-C training for Jayne; rather, she received verbal feedback for correct and incorrect matches during this training phase.

Post-Test Probes

Post-test probes were identical to pre-test probes and were conducted immediately following the demonstration of mastery criterion during conditional discrimination training.

Post-Test Generalization Probes

Post-test generalization probes were identical to pre-test generalization probes and were conducted one day immediately following the demonstration of untrained vocal requests.

Dependent Measure and Interobserver Agreement

The dependent measure was the percentage of correct requests, tacts, and stimulus relations shown during pre- and post-test probe trials for each participant. An untrained request was defined as the use of a category name to request stimuli A1, A2, A3, C1, C2, or C3 on at least 16/18 trials (89%) during post-test probes. An untrained tact was defined as the use of a category name to label those same stimuli on at least 16/18 trials during post-test probes. Stimulus relations were inferred if a participant performed correctly on 8/9 trials (93%) for a particular relation (i.e., B-A). Interobserver agreement (IOA) was recorded during 19% of the pre-test probes, 56% of the training sessions, 19% of the post-test probes, and 6% of the pre-test and post-test generalization probes. IOA was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%. The resulting mean agreement was 100%.

RESULTS

Josh

Pre-Test Probes

Requests and tacts. As shown in Figure 1,

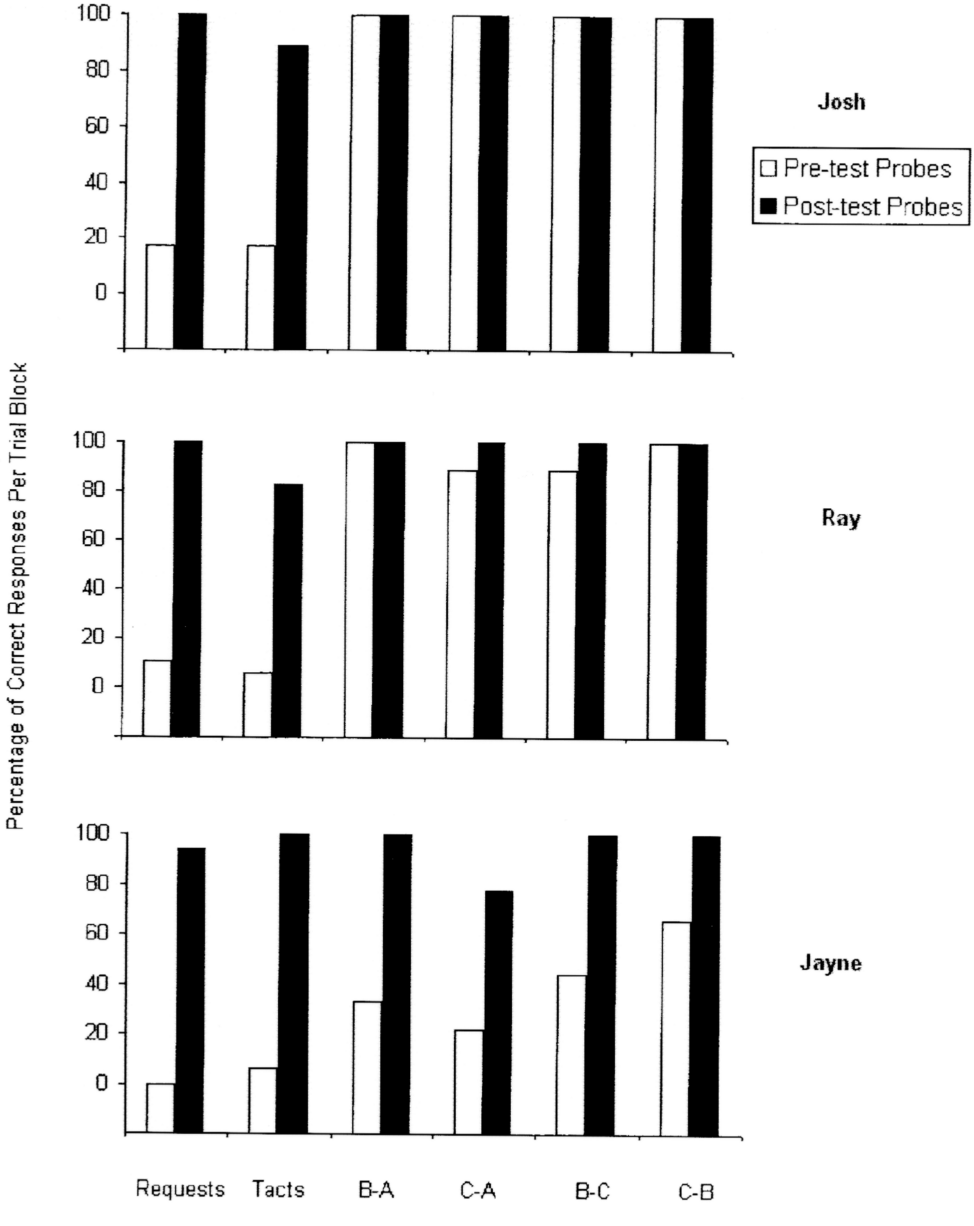

Figure 1. Percentage of correct responses per trial block during pre-test and post-test probes.

Josh responded correctly on 17% (3/18) of both the request and tact pre-test probe trials.

Stimulus relations. As shown in Figure 1, Josh performed with 100% (9/9) accuracy on the B-A, C-A, B-C, and C-B relations. Thus, Josh had mastered the stimulus relations prior to the experiment.

Pre-test generalization probes. During pre-test probes, as shown in Figure 3, Josh responded correctly on 11% (2/18) of the request trials and 17% (3/18) of the tact trials. Josh performed with 89% (8/9) accuracy on the B-A relations, and with 100% (9/9) accuracy on the C-A, C-B, and B-C relations.

Training

Vocal request training. Figure 2 shows Josh's performance during vocal request and conditional discrimination training. The figure shows that Josh performed with 33% (3/9) accuracy

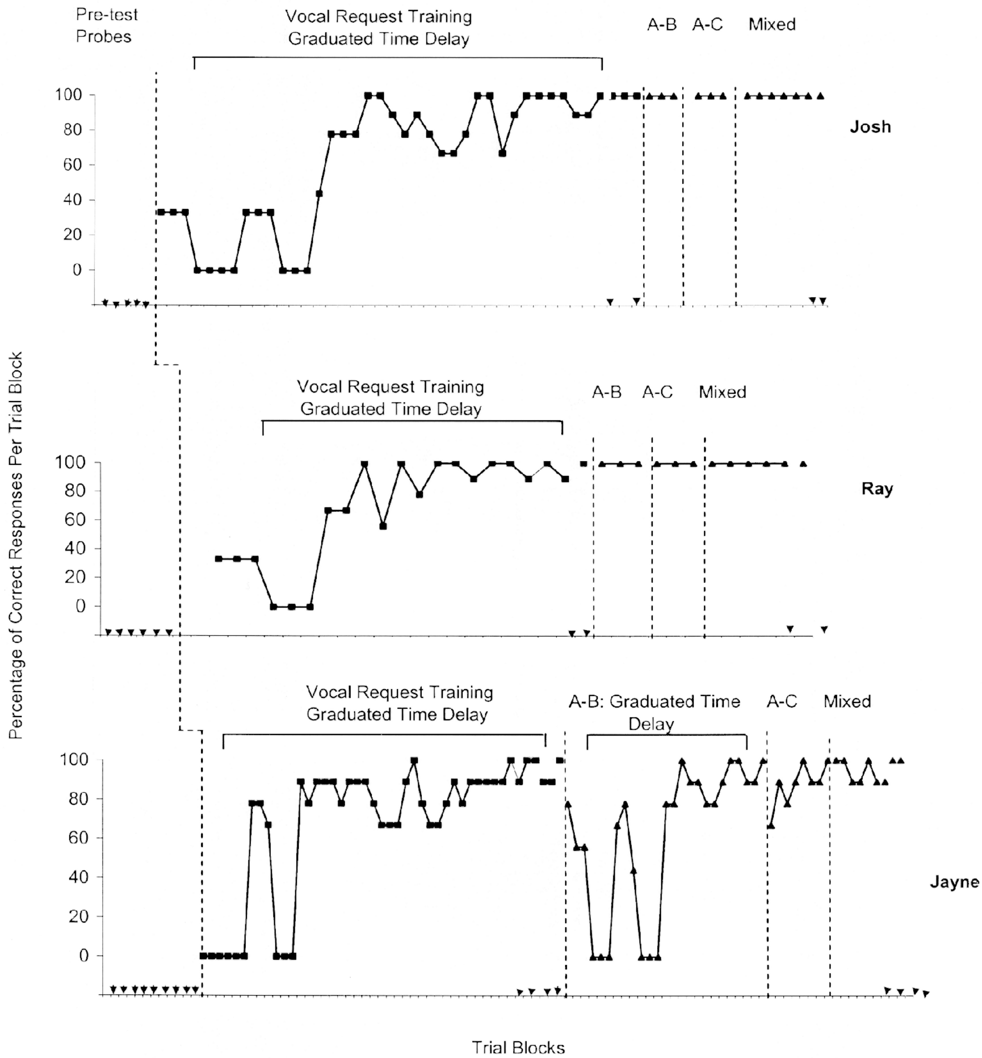

Figure 2. Percentage of correct responses per block during requesting and conditional discrimination training. Downward arrows depict when test probe trials for request, tact, and stimulus relations were presented.

on three consecutive nine-trial blocks prior to the initiation of the graduated time delay procedure, after which Josh eventually demonstrated criterion performance within 34 training blocks.

Conditional discrimination training. Josh demonstrated criterion performance within nine trial blocks, as shown in Figure 2. Thus, Josh had mastered the conditional discriminations prior to the experiment.

Test Probes

Requests and tacts. The following data are not presented in Figures 1–3; rather, the downward arrows along the x axis in Figure 2 depict when, over the course of the experiment, test probe trials were presented for Josh. On the probe trials that were presented following request training, Josh responded correctly on 22% (4/18) of both the untrained request and tact trials. Josh responded correctly on 33% (3/9) of the request test trials for the B stimuli, and 33% (3/9) accuracy on the tact test trials for the B stimuli. Three trial blocks of request training were repeated, after which test probes were again conducted. Josh responded correctly on 67% (12/18) of the untrained request

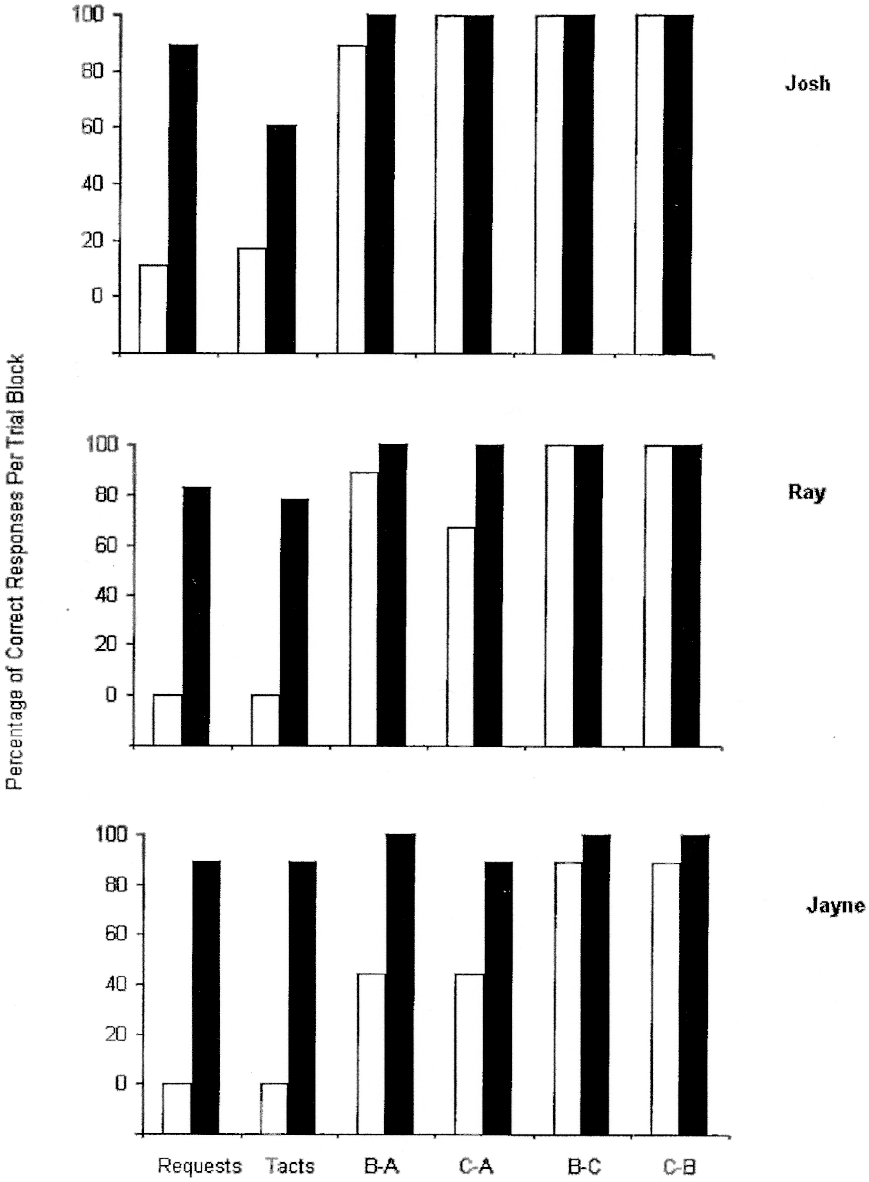

Figure 3. Percentage of correct responses per trial block during pre-test and post-test generalization probes.

trials and 56% (10/18) of the untrained tact trials, 89% (8/9) of the request trials for the B stimuli, and 44% (4/9) of the tact trials for the B stimuli.

Following conditional discrimination training, Josh responded correctly on 67% (12/18) of the untrained request trials and 72% (13/18) of the untrained tact trials. He responded correctly on 100% (9/9) of the request trials for the B stimuli, and 78 % (7/9) of the tact test trials for the B stimuli. One block of request training and mixed conditional discrimination training was re-implemented, after which test probes were again conducted. Figure 1 shows that Josh responded correctly on 100% (18/18) of the final untrained request post-test probes and 89% (16/18) of the final untrained tact post-test probes. He also responded correctly on 100% (9/9) of the request trials for the B stimuli and 78% (7/9) of the tact test trials for the B stimuli (the latter data are not shown in the figure).

Stimulus relations. Only Josh's final performance on the stimulus relations test probes is presented. The downward arrows along the x axis in Figure 2 depict when test probe trials were presented for Josh. Josh performed with 100% accuracy on all test probe trials that were presented, including the final stimulus relation post-test probes, as shown in Figure 1.

Post-test generalization probes. Figure 3 shows that Josh responded correctly on 89% (16/18) of the request probe trials and on 61% (11/18) of the tact test probe trials in the generalization setting. Josh performed with 100% (9/9) accuracy on all four of the stimulus relations tested (B-A, C-A, B-C, C-B) in the generalization setting.

Ray

Pre-Test Probes.

Requests and tacts. As shown in Figure 1, Ray responded correctly on 11% (2/18) of the request pre-test probe trials, and 6% (1/18) of the tact pre-test probe trials.

Stimulus relations. Figure 1 shows that Ray performed with 100% (9/9) accuracy on the B-A relations, 89% (8/9) accuracy on the C-A relations, 89% (8/9) accuracy on the B-C relations, and 100% (9/9) accuracy on the C-B relations. Thus, Ray had mastered the stimulus relations prior to the experiment.

Pre-test generalization probes. Figure 3 shows that Ray responded correctly on 0% (0/18) of both the request and tact probe trials. Ray performed with 89% (8/9) accuracy on the B-A relations, 67% (6/9) accuracy on the C-A relations, and 100% (9/9) accuracy on the B-C and C-B relations.

Training

Vocal request training. Figure 2 shows Ray's performance during vocal request and conditional discrimination training. The figure shows that Ray performed with 33% (3/9) accuracy on three consecutive blocks of nine trials prior to initiation of the graduated time delay procedure, after which Ray eventually demonstrated criterion performance within 17 training blocks.

Conditional discrimination training. Ray demonstrated criterion performance within nine trial blocks, as shown in Figure 2. Thus, Ray had mastered the conditional discriminations prior to the experiment.

Test Probes.

Requests and tacts. The following data are not presented in Figures 1–3; rather, the downward arrows along the x axis in Figure 2 depict when, over the course of the experiment, test probe trials were presented for Ray. On the probe trials that were presented following request training, Ray responded correctly on 44% (8/18) of the untrained request and 89% (16/18) of the untrained tact trials. Ray responded correctly on 100% (9/9) of the request test trials for the B stimuli, and 78% (7/9) of the tact test trials for the B stimuli.

Following conditional discrimination training, Ray responded correctly on 56% (10/18) of the untrained request trials and 67% (12/18) of the untrained tact trials. Ray responded correctly on 100% (9/9) of the request test trials for the B stimuli, and 89 % (8/9) of the tact test trials for the B stimuli. One block of request training and mixed conditional discrimination training was re-implemented, after which test probes were again conducted. Figure 1 shows that Ray responded correctly on 100% (18/18) of the final untrained request post-test probes, and 83% (15/18) of the final untrained tact post-test probes. Ray responded correctly on 100% (9/9) of the request trials for the B stimuli and 100% (9/9) of the tact trials for the B stimuli (the latter data are not shown in the figure).

Stimulus relations. Only Ray's final performance on stimulus relations test probes is presented. The downward arrows along the x axis in Figure 2 depict when test probe trials were presented for Ray. Ray performed with 100% accuracy on all test probe trials that were presented, including the final stimulus relation post-test probes, as shown in Figure 1.

Post-test generalization probes. Figure 3 shows that Ray responded correctly on 83% (15/18) of the untrained request trials, and 78% (14/18) of the untrained tact trials. Ray performed with 100% (9/9) accuracy on all four of the stimulus relations tested.

Jayne

Pre-test Probes

Requests and tacts. As shown in Figure 1, Jayne responded correctly on 0% (0/18) of the request and 6% (1/18) of the tact pre-test probe trials.

Stimulus relations. Figure 1 shows that Jayne performed with 33% (3/9) accuracy on test trials for the B-A relations, 22% (2/9) accuracy on test trials for the C-A relations, 44% (4/9) accuracy on test trials for the B-C relations, and 66% (6/9) accuracy on test trials for the C-B relations.

Pre-test generalization probes. As shown in Figure 3, Jayne responded correctly on 0% (0/18) of both the request and tact probe trials. Jayne performed with 44% (4/9) accuracy on test trials for the B-A and C-A relations, and 89% (8/9) accuracy on test trials for the B-C and C-B relations.

Training

Vocal request training. Figure 2 shows Jayne's performance during vocal request and conditional discrimination training. The figure shows that Jayne performed with 0% (0/9) accuracy during request training prior to initiation of the graduated time delay procedure, after which Jayne eventually demonstrated criterion performance within 42 training blocks.

Conditional discrimination training. Figure 2 shows that Jayne demonstrated criterion performance within 39 training blocks.

Test Probes

Requests and tacts. The following data are not presented in Figures 1–3; rather, the downward arrows along the x axis in Figure 2 depict when, over the course of the experiment, test probe trials were presented for Jayne. On the probe trials that were presented following request training, Jayne responded correctly on 28% (5/18) of the untrained request probe trials and 0% (0/18) of the untrained tact probe trials. Jayne responded correctly on 89% (8/9) of the request test trials for the B stimuli, and 44% (4/9) of the tact test trials for the B stimuli.

Following the mastery of the conditional discriminations, Jayne responded correctly on 28% (5/18) of the untrained request probe trials and 33% (6/18) of the untrained tact probe trials. Jayne responded correctly on 67% (6/9) of the request trials for the B stimuli, and 33% (3/9) of the tact trials for the B stimuli. One block of request training and mixed conditional discrimination training was re-implemented, after which test probes were again conducted. Jayne responded correctly on 72% (13/18) of the untrained request trials and 44% (8/18) of the untrained tact test trials. Jayne responded correctly on 100% (9/9) of the request trials for the B stimuli, and 100% (9/9) of the tact trials for the B stimuli. One block of request training and mixed conditional discrimination training was again re-implemented, after which test probes were again conducted. Jayne responded correctly on 83% (15/18) of the untrained request trials, and on 72% (13/18) of the untrained tact trials. Jayne responded correctly on 100% (9/9) of the request trials for the B stimuli, and 100% (9/9) of the tact test trials for the B stimuli. One block of request training and mixed conditional discrimination training was again re-implemented, after which the final test probes were conducted. Figure 1 shows that Jayne responded correctly on 94% (17/18) of the final untrained request post-test probes, and 100% (18/18) of the final untrained tact post-test probes. Jayne responded correctly on 100% (9/9) of the request trials for the B stimuli, and 100% (9/9) of the tact trials for the B stimuli (the latter data are not shown in the figure).

Stimulus relations. Only Jayne's final performance on stimulus relations test probes is presented. The downward arrows along the x axis in Figure 2 depict when test probe trials were presented for Jayne. Following request training, Jayne responded with 44% (4/9) accuracy on test trials for the B-A relations, 56% (5/9) accuracy on test trials for the C-A relations, 78% (7/9) accuracy on test trials for the B-C relations, and 89% (8/9) accuracy on test trials for the C-B relations. Upon the completion of conditional discrimination training, Jayne responded with 100% (9/9) accuracy on test trials for the B-A and C-B relations, and 89% (8/9) accuracy on test trials for the C-A and B-C relations. Stimulus relations test probes continued to be presented each time request and tact test probes were re-administered to Jayne; she demonstrated criterion performance on all of them. Her final performance on stimulus relations probe trials is shown in Figure 1. Jayne performed with 100% (9/9) accuracy on the B-A, B-C, and C-B test trials, and 78% (7/9) accuracy on the C-A test trials.

Post-test generalization probes. Figure 3 shows that Jayne responded correctly on 89%

(16/18) of the untrained request test probe trials, and 89% (16/18) of the untrained tact test trials. Jayne performed with 100% (9/9) accuracy on test trials for the B-A, B-C, and C-B relations, and 89% (8/9) accuracy on test trials for the C-A relations.

DISCUSSION

The results of this experiment suggest that reinforced relational responding may facilitate the emergence of untrained requests in adults with severe developmental disabilities. All three participants vocally requested novel items on the basis of those items' participation in relational frames with preferred items for which participants had been explicitly taught to request. Thus, the expansion of mand repertoires via relational responding may be an effective and efficient means of programming for the emergence of a number of new skills. The ability to use categorical names to request preferred items may have important benefits for individuals in many areas of community living. In addition, changes in the mand repertoire were accompanied by changes in the tact repertoire for all three participants, although only Josh and Jayne demonstrated the criterion for inferring the emergence of untrained tacts. These results suggest that the mand and tact repertoires may be functionally dependent, thus converging with results from previous research (Sundberg et al.,1990; Drash et al., 1999; Twyman, 1996). Finally, some emergent skills were shown to generalize across settings for some of the participants: Josh and Jayne both showed the generalization of requests across settings, and Jayne, who is the only participant for whom the relations between categorically related stimuli were not intact prior to the experiment, showed the generalization of tacts and stimulus relations across settings.

Jayne's results are particularly noteworthy, as, unlike Josh and Ray, Jayne had no prior learning history with the particular stimulus relations established during the study. For Jayne, the skills observed during post-test probe trials could only have emerged on the basis of her experimental history. Although this is not the case for Josh and Ray, their results are also significant, as the transfer of discriminative functions for requesting occurred following exposure to the conditional discrimination task for both participants. Given that both participants demonstrated criterion performance on pre-test probe trials for the stimulus relations, it is somewhat surprising that neither participant demonstrated untrained requests until they were exposed to the conditional discrimination task. In fact, both participants required remedial conditional discrimination and request training before showing the emergence of untrained requests. One possible explanation for this finding is that the formal demonstration of relations between the stimuli, as occurred during the conditional discrimination task, was necessary for the discriminative functions to transfer (see McIlvane & Dube, 1990). A second possible conceptualization of this finding is that relational responding during conditional discrimination training and testing procedures is selection-based responding, which may not necessarily facilitate the emergence of topography-based relational responding, such as vocal naming or requesting (see Polson & Parsons, 2000). A final possibility is that the context for requesting preferred items using their category names was simply not functional until participants had had repeated exposure to the training and testing procedures.

A practical limitation of this study is the amount of remedial training necessary for all of the participants to demonstrate untrained requests. Jayne, most importantly, required three remedial training sessions after mastering the conditional discriminations in order to show the emergence of untrained requests. Repeated remedial training can add significantly to the total training time. For this reason, future research should compare the amount of training time necessary to establish untrained requests relative to the amount of time utilized to directly teach every single targeted skill. Future research should also replicate this procedure with additional individuals who, like Jayne, had not acquired the stimulus relations prior to the experiment.

The procedure used in this study gives rise to an important theoretical question, that being whether participants' requests truly functioned as mands or functioned as some other verbal operant. It was not clear that participants were deprived of their preferred items during experimental sessions, so it cannot be unequivocally determined that requests were under the control of establishing operations (see Michael, 1988; Hall & Sundberg, 1987). In addition, a preferred item was present on each trial, such that participants' requests may have functioned as partial tacts. Thus, the repertoires established in this study may be more appropriately conceptualized as multiply-controlled mand-tacts (the reader is referred to Bondy, Tincani, & Frost, 2004, for a discussion of multiply-controlled verbal operants). Because participants learned to answer the questions "What do you want?" and "What is this?" Skinner's (1957) definition of the intraverbal, a verbal operant evoked by a verbal stimulus in which the response shares no point-to-point correspondence with that stimulus, may also characterize participants' performances. Future research aimed at establishing derived mands should ensure that requests are exclusively under the control of establishing operations.

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